

NON-DISRUPTIVE COMPUTER-CONTROLLED IN-LINE CONVEYOR FLOW
WEIGHT CALIBRATION SCALE

Invented by

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1 NON-DISRUPTIVE COMPUTER-CONTROLLED IN-LINE CONVEYOR FLOW

2 WEIGHT CALIBRATION SCALE

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5 Field of the Invention

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7 This invention relates to weight sensing systems for
8 article transporting conveyors and to associated
9 calibration systems.

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11 Background of the Invention

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13 Weighing systems for conveyor assemblies that
14 transport articles along a specified path are well known.
15 Because of the prolonged and continual operation of such
16 weighing systems, recalibration is often required in order
17 to maintain consistent and accurate weight measurements.

18 For many calibration systems, it is necessary to
19 temporarily interrupt the operation of the conveyor in
20 order facilitate a calibration event, often resulting in
21 recalibration of the weighing system. This checking
22 procedure not only required the attention of personnel but
23 also involved a loss of production time because of the
24 interruption in conveyor operation. Other calibration

1 systems do not require interruption of the conveyer but
2 require an interruption of the operation of the weighing
3 system, which is unfortunate because it prevents the
4 weighing system from weighing material on the conveyor.
5 Given these and other deficiencies in the art, the need for
6 certain new and useful improvements is evident.

1 Summary of the Invention

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3 The above problems and others are at least partially
4 solved and the above purposes and others realized in a
5 first embodiment of the invention, which is characterized
6 by a new and novel combination consisting of a weighing
7 system that is capable of continually sensing load against
8 a continuously moving conveyor and a calibration system for
9 the weighing system that is capable of applying a reference
10 load to the weighing system without interrupting the
11 ability of the weighing system to sense load against the
12 conveyor. In a preferred embodiment, the weighing system
13 consists of a pivoted scale engaging the conveyor and a
14 sensor that is capable of producing load stimulus in
15 response to displacement of the pivoted scale by load
16 applied against the conveyor. The calibration system
17 consists of a reference load capable of being displaced and
18 the sensor capable of producing test load stimulus in
19 response to displacement of the pivoted scale by load
20 applied against the conveyor and displacement of the
21 reference load. A pivoted test beam supports the reference
22 load, which is capable of pivoting between a first position
23 and a second position displacing the reference load. An
24 engine is associated with the pivoted test beam and is

1 movable between a first condition corresponding to the
2 first position of the test beam and a second condition
3 corresponding to the second position of the test beam.
4 Preferably, the invention is furnished with storage
5 maintaining load stimulus data from the sensor commensurate
6 with load applied to the conveyor and a test load stimulus
7 data from the sensor commensurate with a combination of
8 load applied to the conveyor and displacement of the
9 reference load, and a controller that is capable of
10 comparing the load stimulus data to the test load stimulus
11 data and adjusting the weighing system if the comparison of
12 the load stimulus data and the test load stimulus data is
13 unacceptable.

14

15 In a conveyor continuously moving material, the
16 material applying load to the conveyor, another embodiment
17 of the invention proposes a weighing system that is capable
18 of continually sensing load against the conveyor and a
19 calibration system for the weighing system that is capable
20 of applying a reference load to the weighing system without
21 interrupting the ability of the weighing system to sense.
22 load against the conveyor. In this preferred embodiment,
23 the weighing system consists of a pivoted scale engaging
24 the conveyor and a sensor that is capable of producing load

1 stimulus in response to displacement of the pivoted scale
2 by load applied against the conveyor. The calibration
3 system consists of a reference load capable of being
4 displaced and the sensor capable of producing test load
5 stimulus in response to displacement of the pivoted scale
6 by load applied against the conveyor and displacement of
7 the reference load. A pivoted test beam supports the
8 reference load, which is capable of pivoting between a
9 first position and a second position displacing the
10 reference load. An engine is associated with the pivoted
11 test beam and is movable between a first condition
12 corresponding to the first position of the test beam and a
13 second condition corresponding to the second position of
14 the test beam. Preferably, the instant embodiment of
15 invention is furnished with storage maintaining load
16 stimulus data from the sensor commensurate with load
17 applied to the conveyor and a test load stimulus data from
18 the sensor commensurate with a combination of load applied
19 to the conveyor and displacement of the reference load, and
20 a controller that is capable of comparing the load stimulus
21 data to the test load stimulus data and adjusting the
22 weighing system if the comparison of the load stimulus data
23 and the test load stimulus data is unacceptable.

1 In yet another preferred embodiment the invention
2 consists of a conveyor, a weighing system consisting of a
3 load sensor and a scale displaced by the conveyor so as to
4 act on the load sensor, and a reference load capable of
5 being displaced so as to act on the load sensor. In this
6 embodiment, a pivoted test beam supports the reference
7 load, which is movable between a first position and a
8 second position displacing the reference load. An engine
9 is associated with the pivoted test beam and is movable
10 between a first condition corresponding to the first
11 position of the test beam and a second condition
12 corresponding to the second position of the test beam.
13 Preferably, this embodiment of the invention is further
14 furnished with storage maintaining load stimulus data from
15 the load sensor commensurate with load applied to the
16 conveyor and a test load stimulus data from the load sensor
17 commensurate with a combination of load applied to the
18 conveyor and displacement of the reference load, and a
19 controller capable of comparing the load stimulus data to
20 the test load stimulus data and adjusting the weighing
21 system if the comparison of the load stimulus data and the
22 test load stimulus data is unacceptable.

23

24 Consistent with the foregoing the invention also

1 contemplates associated methods. In a preferred
2 embodiment, an exemplary method of the invention is carried
3 out in a conveyor and a weighing system that is capable of
4 continually sensing load against the conveyor and
5 generating load stimulus commensurate with the load against
6 the conveyor. The method consists of applying a reference
7 load to the weighing system, generating test load stimulus
8 commensurate with a combination of the load against the
9 conveyor and the reference load against the weighing
10 system, comparing the test load stimulus with the load
11 stimulus, and adjusting the weighing system if the
12 comparison of the load stimulus and the test load stimulus
13 is unacceptable. Preferably, a load cell generates the
14 test load stimulus, and a controller carries out the
15 comparison and adjusting tasking events. However, these
16 events can be carried out manually if desired.

1 BRIEF DESCRIPTION OF THE DRAWINGS

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3 Referring to the drawings:

4

5 FIG. 1 is a perspective view of a conveyor associated
6 with a weighing and calibrating system, in accordance with
7 the principal of a preferred embodiment of the invention;

8

9 FIG. 2 is a diagrammatic view illustrating the
10 weighing and calibrating system of FIG. 1; and

11

12 FIG. 3 is a perspective view of a conveyor associated
13 with a weighing and calibrating system, in accordance with
14 the principal of another preferred embodiment of the
15 invention.

1 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

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3 In general, the invention is a new and novel
4 combination consisting of a weighing system that is capable
5 of continually sensing load against a continuously moving
6 conveyor and a calibration system for the weighing system
7 that is capable of applying a reference load to the
8 weighing system without interrupting the ability of the
9 weighing system to sense load against the conveyor. In a
10 preferred embodiment, the weighing system consists of a
11 pivoted scale engaging the conveyor and a sensor that is
12 capable of producing load stimulus in response to
13 displacement of the pivoted scale by load applied against
14 the conveyor. The calibration system consists of a
15 reference load capable of being displaced and the sensor
16 capable of producing test load stimulus in response to
17 displacement of the pivoted scale by load applied against
18 the conveyor and displacement of the reference load. A
19 pivoted test beam supports the reference load, which is
20 capable of pivoting between a first position and a second
21 position displacing the reference load. An engine is
22 associated with the pivoted test beam and is movable
23 between a first condition corresponding to the first
24 position of the test beam and a second condition

1 corresponding to the second position of the test beam.
2 Preferably, the invention is furnished with storage
3 maintaining load stimulus data from the sensor commensurate
4 with load applied to the conveyor and a test load stimulus
5 data from the sensor commensurate with a combination of
6 load applied to the conveyor and displacement of the
7 reference load, and a controller that is capable of
8 comparing the load stimulus data to the test load stimulus
9 data and adjusting the weighing system if the comparison of
10 the load stimulus data and the test load stimulus data is
11 unacceptable.

12

13 Turning now to the drawings, in which like reference
14 characters indicated corresponding elements throughout the
15 several views, FIGS. 1 and 2 illustrate a preferred
16 embodiment of the invention designated 10, which consists
17 of a continuously moving conveyor 11 associated with a
18 weighing and calibrating system 12 disposed between support
19 rollers 14,16 (roller 16 shown only in FIG. 2) supporting
20 an upper run of an endless conveyor belt 18 of conveyor 11
21 on which material or articles, such as article 20, are
22 transported in a specified direction. Brackets 22 of a
23 frame 24 associated with conveyor 11 rotatably attach
24 rollers 14,16 for the upper run of conveyor belt 18.

1 Conveyor 11 is maintained in continuous operation for
2 movement of material/articles in the specified direction,
3 which, in this embodiment, is a right hand direction as
4 viewed in FIGS. 1 and 2, with the material/articles thereon
5 moving through a weighing station between support rollers
6 14,16 so that the weight/load of the material/articles
7 against conveyor belt 18 of conveyor 11 is sensed by
8 weighing system 12.

9

10 Weighing system 12 includes a scale beam assembly 26,
11 which is pivoted at one end by, in this specific
12 embodiment, a pivot shaft 28 supported by and between
13 brackets 30 of frame 24 adjacent support roller 14. Scale
14 beam assembly 26 underlies the upper run of conveyor belt
15 18 and mounts intermediate the ends thereof. Brackets 31
16 rotatably support a load-applying roller 32, which is
17 maintained in engagement with the underside of the conveyor
18 belt 18 so that the load on conveyor belt 18 is applied to
19 scale beam assembly 26 displacing it and thus permitting it
20 to weigh material/articles carried by conveyor belt 18.
21 The end of scale beam assembly 26 remote from pivot shaft
22 28 is characterized by an extremity/arm 34 to which is
23 connected a load cell 36, which is mounted on a supporting
24 frame member 38 underlying arm 34. Load cell 36 is any

1 suitable type well known to those skilled in the art, the
2 details of which will readily occur to the skilled artisan.

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4 Load cell 36 is connected to a source of voltage that,
5 in this preferred embodiment, is in the form of a powered
6 computerized processing unit/controller 40 in order to
7 produce load stimulus in the form of a signal output
8 reflecting the load applied to load cell 36 through arm 34
9 of scale beam assembly 26. The load stimulus from load
10 cell 36 is fed to controller 40 and stored into electronic
11 storage of controller 40. The electronic storage is any
12 suitable type commonly found with conventional personal
13 computers and other ubiquitous computing devices, whether
14 transient/temporary storage or permanent storage. If
15 desired, load cell 36 can be associated with an amplifier
16 transmitter for amplifying the load stimulus or output from
17 load cell 36 and an integrator producing a suitable output
18 to controller 40. Controller 40 appropriately processes
19 and stores into the associated electronic storage the load
20 stimulus of load cell 36. The load stimulus is converted
21 by controller 40 into a measured value that reflects a
22 measurement of load carried by conveyor belt 18. Further
23 details of the operation of controller 40 will be discussed
24 later in this specification.

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1 Also underlying the top run of conveyor belt 18
2 between support rollers 14,16 is a test beam assembly 48,
3 which is pivotally attached by a fulcrum bracket assembly
4 50 intermediate the ends thereof. A support frame 52
5 mounts fulcrum assembly 50 intermediate the ends of scale
6 beam assembly 26 so that one end portion 54 of the test
7 beam assembly 48 underlies scale beam assembly 26 while the
8 other end portion 56 projects upwardly through scale beam
9 assembly 26 and overlies arm 34. A reference weight 58 is
10 suspended from end portion 56 of test beam assembly 48 on
11 one side of fulcrum assembly 50 so that the load thereof is
12 capable of being transferred to arm 34 in response to
13 angular displacement of test beam assembly 48 in a
14 clockwise direction about fulcrum assembly 50 as viewed in
15 FIGS. 1 and 2. Test beam assembly 48 is angularly
16 displaced in this direction in order to displace/transfer
17 reference weight 58 to load cell 36 by an engine, which in
18 this embodiment is a power operated device in the form of
19 an air cylinder mechanism 60. Air cylinder mechanism 60 is
20 pivotally anchored on a support frame 62 underlying end
21 portion 54 of test beam assembly 48 while a piston rod 64
22 extends upwardly from air cylinder mechanism 60 and is
23 pivotally connected to end portion 54. Although air
24 cylinder mechanism 60 is a preferred engine, other engine

1 forms capable of angularly displacing test beam assembly 48
2 can be employed without departing from the invention.

3

4 Load applying roller 32 is disposed against the
5 underside of conveyor belt 18 bearing the weight of loads
6 disposed on the upper side of conveyor belt 18 displacing
7 scale beam assembly 26. This displacement of scale beam
8 assembly 26 causes arm 34 to act on load cell 36, in which
9 load cell 36 generates output signals, namely, load
10 stimulus, commensurate with the load, force or weight
11 exerted thereagainst by arm 34. In this embodiment, arm 34
12 acts on load cell 36 with a pressing force. This force can
13 be a pulling force, which is discussed in connection with
14 the embodiment depicted in FIG. 3. Load stimulus/signals
15 generated at load cell 36 are sent to controller 40 and
16 stored into and maintained by electronic storage.

17

18 Reference weight 58 is a known weight. Upward
19 displacement of end portion 54 of test beam assembly 48 by
20 air cylinder mechanism 60 transfers reference weight 58 to
21 weighing system 12 and, thus, to load cell 36. This does
22 not disrupt the interaction of conveyor belt 18 with roller
23 32 and, thus, with scale beam assembly 26. In this regard,
24 and in accordance with the principal of the invention,

1 scale beam assembly 26 is always in operative relationship
2 with conveyor 11. The applied reference weight 58 acts on
3 load cell 36 in addition to the force exerted against load
4 cell 36 by arm 34, in which load cell 36 generates load
5 stimulus commensurate with the force or weight exerted
6 thereagainst by reference weight 58 and the load exerted
7 against scale beam assembly 26 by conveyor 11. In this
8 embodiment, reference weight 58 acts against arm 34 with a
9 pressing force, which pressing force transfers to load cell
10 36 by way of arm 34. This force can be a pulling force
11 against arm 34 if desired. When reference weight 58 is
12 loaded against load cell 36, the load stimulus generated by
13 load cell 36 are considered test load stimulus or signals,
14 which test load stimulus/signals are sent to controller 40
15 and stored into and maintained by electronic storage.

16

17 Air cylinder mechanism 60 is activated during a test
18 interval to upwardly displace end portion 54 transferring
19 reference weight 58 against arm 34 and, therefore, to load
20 cell 36. Activation of air cylinder assembly 60 is
21 characterized by a pressurization of air cylinder mechanism
22 60, which, for instance, is caused by supplying air
23 cylinder assembly 60 with air under pressure through, for
24 example, a line connected by a snubber to one of the outlet

1 ports of a solenoid valve assembly connected to a suitable
2 source of air under pressure. At the end of the test
3 interval, air cylinder mechanism 60 is deactivated to
4 downwardly displace end portion 54 disengaging reference
5 weight 58 from arm 34 and, therefor, from load cell 36.
6 Deactivation of air cylinder mechanism 60 is characterized
7 by a de-pressurization of air cylinder mechanism 60, which,
8 for instance, is caused by relieving air cylinder assembly
9 60 of air pressure by, for example, interconnecting air
10 cylinder mechanism 60 with the solenoid valve assembly
11 through the snubber.

12

13 Closing and opening a switch 84 (FIG. 2), which can be
14 done manually or by controller 40 and preferably by the
15 latter, carries out the activation and deactivation of air
16 cylinder assembly 60. Controller 40 is programmable, and
17 preferably programmed to carry out calibration tests with
18 test arm assembly 48 at regular or specified intervals. In
19 accordance with a preferred embodiment, controller 40
20 programming governs the frequency with which weighing
21 system 12 is checked for calibration as well as the
22 duration of the test interval during which calibration is
23 checked and automatic adjustment of weighing system 12
24 effected if necessary.

1 In a test interval, in which reference weight 58 is
2 loaded to load cell 36 in the manner previously described,
3 test load stimulus is generated by load cell 36 and sent to
4 controller 40 and stored into and maintained by the
5 electronic storage thereof. This test load stimulus, which
6 is commensurate to the weight or load applied by
7 material/articles on conveyor belt 18 plus the weight or
8 load applied by reference weight 58, is compared by
9 controller 40 to stored load stimulus, which is
10 commensurate to the weight or load applied only by
11 material/articles on conveyor belt 18. Controller 40
12 compares the weight represented by the load stimulus and
13 test load stimulus and calculates the difference between
14 the two, which, if weighing system 12 is calibrated
15 properly, will be equal or at least substantially equal to
16 the weight of reference weight 58, which is a known weight.
17 If as calculated by controller 40 the difference between
18 the weights represented by the load stimulus and the test
19 load stimulus is zero, negligible or otherwise falls within
20 a specified range, controller 40 terminates the test
21 interval deactivating air cylinder assembly 60 removing the
22 load of reference weight 58 from load cell 36. If as
23 calculated by controller 40 the difference between the
24 weights represented by the load stimulus and the test load

1 stimulus is not zero, not negligible or otherwise falls
2 outside a specified range, controller 40 initiates a
3 adjustment or recalibration event for weighing system 12.
4 In this adjustment event, controller 40 adjusts the
5 weighing parameters of weighing system 12 and then
6 initiates another testing event, in which controller 40
7 accepts another test load stimulus from load cell 36 and
8 compares the weight represented by the new test load
9 stimulus to the weight represented by the load stimulus.
10 If as calculated by controller 40 the difference between
11 the weights represented by the load stimulus and the new
12 test load stimulus is zero, negligible or otherwise falls
13 within a specified range, weighing system 12 is deemed
14 recalibrated and controller 40 terminates the test interval
15 deactivating air cylinder assembly 60 removing the load of
16 reference weight 58 from load cell 36. If as calculated by
17 controller 40 the difference between the weights
18 represented by the load stimulus and the new test load
19 stimulus is not zero, not negligible or otherwise falls
20 outside a specified range, weighing system 12 is deemed not
21 recalibrated and controller 40 initiates another
22 recalibration event. Recalibration events are repeated by
23 controller 40 until weighing system 12 is deemed
24 recalibrated, in which case controller 40 terminates the

1 test interval deactivating air cylinder assembly 60
2 removing the load of reference weight 58 from load cell 36.
3 It should be noted that although controller 40 is the
4 preferred means of conducting calibration tests for
5 weighing system 12, all of or one or more parts or tasks of
6 the foregoing calibration testing can be effected manually
7 if desired.

8

9 Turning now to FIG. 3, illustrated is another
10 embodiment of the invention designated 100. In common with
11 the previously described embodiment designated 10,
12 embodiment 100 shares conveyor 11, weighing system 12,
13 support rollers 14,16 (roller 16 not shown), conveyor belt
14 18, brackets 22, frame 24, scale beam assembly 26, shaft
15 28, brackets 30, brackets 31, roller 32, the controller
16 (not illustrated), test beam assembly 48, bracket assembly
17 50, support frame 52, end portion 54, end portion 56, air
18 cylinder mechanism 60 or other suitable engine as
19 previously explained in connection with the embodiment
20 designated 10 and support frame 62. Unlike the embodiment
21 designated 10, embodiment 100 is furnished with two load
22 cells 101 that overly and are coupled to a distal extremity
23 102 of scale beam assembly 26. Also, end portion 56 is
24 characterized by attached arms 103 to which are connected

1 in a depending state reference weights 104. A channel 105
2 underlies reference weights 104 and is attached to scale
3 beam assembly 26 proximate distal extremity 102.
4 Displacement of scale beam assembly 26 in this embodiment
5 100 results in a pulling force applied to load cells 101.
6 Displacement of test beam assembly 48 applies reference
7 weights 104 against channel 105, which is translated into a
8 pulling force against load cells 101 by scale beam assembly
9 26. The embodiment designated 100 is instructive for
10 illustrating an arrangement of scale beam assembly 26 and
11 test beam assembly 48 in applying a pulling force against
12 load cells 101. The embodiment designated 100 is also
13 instructive for teaching an implementation of a plurality
14 of load cells and reference weights. The embodiment
15 designated 10 can also be furnished with a plurality of
16 load cells and/or reference weights if desired. Also,
17 although two load cells 101 and two reference weights 104
18 are illustrated in the embodiment designated 100, more of
19 each can be used if desired.

20

21 The present invention is described above with
22 reference to preferred embodiments. However, those skilled
23 in the art will recognize that changes and modifications
24 may be made in the described embodiments without departing

1 from the nature and scope of the present invention.
2 Various changes and modifications to the embodiments herein
3 chosen for purposes of illustration will readily occur to
4 those skilled in the art. To the extent that such
5 modifications and variations do not depart from the spirit
6 of the invention, they are intended to be included within
7 the scope thereof.

8

9 Having fully described the invention in such clear and
10 concise terms as to enable those skilled in the art to
11 understand and practice the same, the invention claimed is: